THE IMPORTANCE OF SHELTERBELTS: A CASE STUDY FROM EASTERN HUNGARY

Honfy V[1*], Borovics A[2], Csiha I[1], Rásó J[1], Somogyi N[3], Keserű Zs[1]

* Correpondence author: honfyv@erti.hu

(1) Department of Plantation Forestry, Forest Research Institute (FRI), National Agricultural Research and Innovation Centre (NARIC), Püspökladány, Hungary (2) Department of Tree Breeding, NARIC FRI, Sárvár, Hungary (3) NARIC, Gödöllő, Hungary

Introduction

The concept of agroforestry is rather new to Hungarian farmers and scientists. The Hungarian National Agricultural Research and Innovation Centre's (NARIC) Forest Research Institute (FRI) Department of Plantation Forestry started to study agroforestry systems and constructed its first trials in 2014. Since then further experiments have been set up and the institution has started to spread the knowledge of agroforestry, its characteristics and specialities, through agricultural and forestry forums and conferences, based on international literature, and examples (Keserű 2014). The aim is to establish trials across the whole country, to be able to study different sites where profitable plantation forestry and agroforestry technologies can be tested under the ecosystem of Hungary, providing models, and options to forestry and agriculture in marginal areas.

Deflation is a serious problem in many arid areas of Hungary, as well as erosion in undulating areas where the soil is temporarily uncovered due to conventional agriculture. There is about 700.000 ha arable lands and 100.000 ha grasslands in Hungary with low agroecological potential, where production in the conventional way cannot be sustained (Borovics and Gyuricza 2015).

One of the most effective ways to protect soil from deflation is the application of shelterbelts. Shelterbelts are significant in domestic honey production too. Valuable bee pastures can be established by choosing the species with good care, which provide pollens and nectar for bees (Keresztesi 1975). Application of shelterbelts also affects to carbon fixing advantageously, compared to the monoculture cultivation of plants.

Figure 1: Aerial photograph of the shelterbelt system in Földes, Hungary

This study focuses on representing a special shelterbelt system as a step towards re-establishing shelterbelts in Hungary which used to play an important role of the Hungarian landscape in about the 1960's (Gál and Káldy 1977). The topic is relevant to target the National Forest Programme of Hungary that is to extend the forest cover from the current 21% to 27% (NFCSO 2015). Moreover, agroforestry subsidies are soon to be issued by the government, as part of Horizon 2020 that also encourages farmers to consider agroforestry land use systems and invest in trees in the future.

In 1998 a proper agroforestry system was established in Földes by an organic farmer and beekeeper, Zsigmond Bíró and the Forest Research Institute, although that time the concept of agroforestry was forgotten in Hungary. The site has only recently gained attention after recognizing its unique appearance in the landscape, its role to reduce several harmful effects of climate change, and because it's particularly suitable to carry out agroforestry research in a well-established ecosystem (**Figure 1**). Its investigation is only recently started. The farmer's motivation to establish the shelterbelt was to provide pasture for bees and to utilize the trees within their multipurpose functions, such as living fence, wood for construction, fuel and the farmer also highlights its aesthetic value (**Figure 2**).

Material and methods

The field study was carried out in a 5.1 ha organic agricultural field nearby Földes, where previously sugar beet was produced. The field characteristics were shallow site, meadow solonetz soil turning into steppe formation, with some periodic water effected area. The shape of the field was rectangular, divided into 3 parcels (80m x 80m, 80m x 80m, 80m x 120m) by the shelterbelt, so that the arable lands were surrounded with trees from all the 4 sides. The trees were planted in 8 rows, inter-row spacing was 3 m and in-row spacing was 1 m, making up to 20 m each stripes, covering altogether 3 ha. At the outer edge of the shelterbelt a 5 m stripe was left open field for maintenance, where lucerne was sowed.

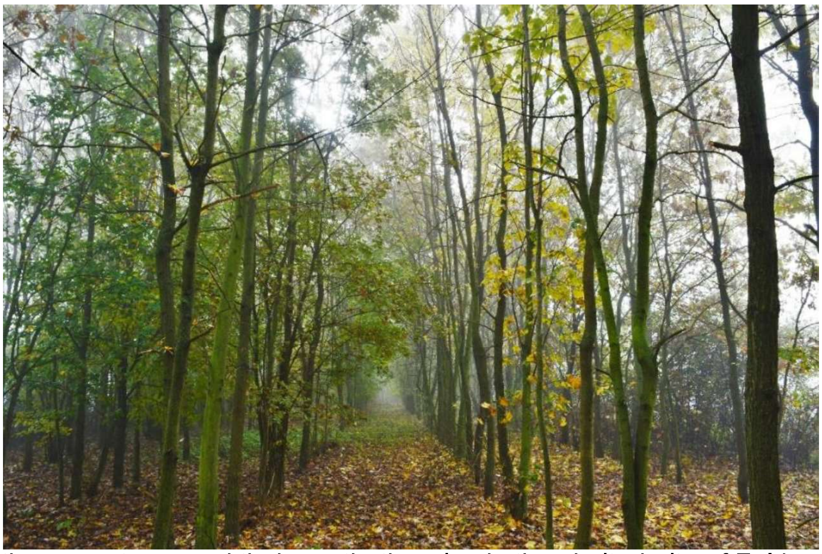


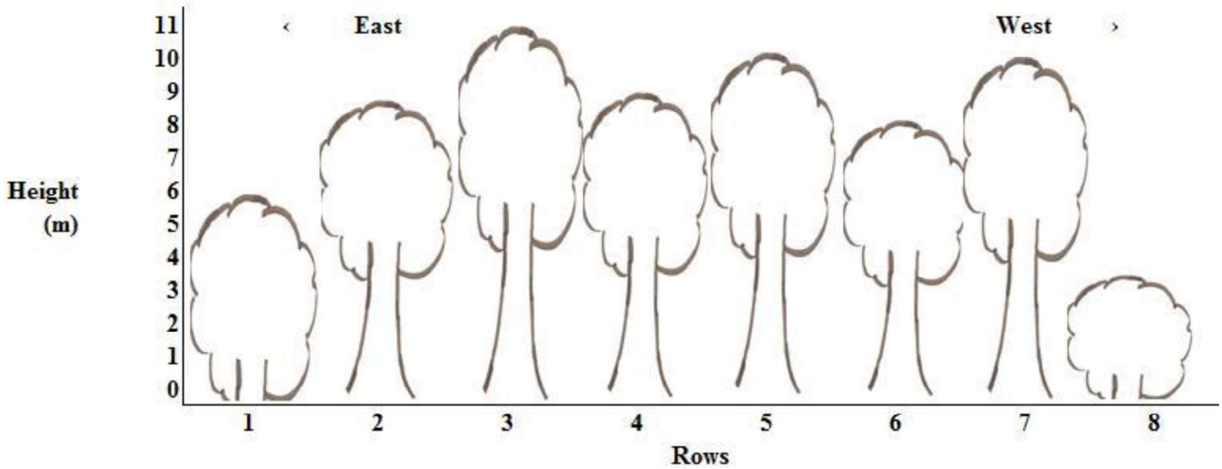
Figure 2: Multipurpose trees and their aesthetic value in the shelterbelts of Földes (Photo: Rásó J)

The trees were not planted with machinery but by hand, because of the size of the trees were different according to the species. The trees were planted according to the Hungarian forestry practice. The species used in the shelterbelt were chosen according to their significance to apiculture, as follows: Hazelnut (*Corylus avellana* L.), Turkish hazel (*Corylus colurna* L.), Cornelian cherry (*Cornus mas* L.), Hagberry (*Padus avium* L.), Judas tree (*Cercis siliquastrum* L), Lily of the valley shrub (*Deutzia spp.*), False indigo (*Amorpha fruticose* L.), Staghorn sumac (*Rhus typhiana* L.), Bee bee tree (*Evodia hupehensis*), Silver mapple (*Acer saccharinum* L.), Common maple (*Acer campestre* L.), Tatarian maple (*Acer tataricum* L.), Wild pear (*Pyrus pyraster* L. Burgsd), Common ash (*Fraxinus excelsior* L.), Russian olive (*Elaeagnus angustifolia* L.), Spiny box-thorn (*Lycium barbarum* L.), Honey tree (*Sophora japonica* L. Schott), Siberian elm (*Ulmus pumila* L. var. arborea cv. Puszta).

In the first two years, the rows were intercropped with maize to reduce windbreak, and under drought conditions, the field was irrigated by water wagon. The in-rows were maintained by manual hoeing. The maintenance was ceased after the canopy has closed. In the enclosed field the farmer produces certified organic oiled pumpkin, spelled wheat, and zucchini for the market.

In the spring of 2016, a forest inventory (stand survey) was conducted. Dendrometric measures were recorded such as diameter at breast hight (DBH) using Haglof caliper with Psion Organizer II, and the hight of the trees and the hight of the canopies, using Vertex Forestor. Moreover, soil samples were taken in the shelterbelt, 15 m (the hight of the highest tree) away from the shelterbelt towards the middle of the enclosed field (assuming that the litter would positively affect the organic matter content of the soil) and in the middle of the enclosed arable land. The samples were taken to assess physical and chemical attributes from 0-30 cm suggesting that in this time frame (17 years) the shelterbelt would only affect the top of the soil layers, and also the roots of crops and tillage didn't take place deeper than 30 cm.

Results
Based on dendrometric measures and visual observation, the ideal structure of the shelterbelt has developed (**Figure 3**). The multilayer canopy, the dense and properly closed hedging provides adequate protection against the wind's negative effects. Various tree species were present with different canopy height and structures, forming extensive surface to direct sunlight to each individual tree compered to shelterbelts consisting of only a few species.



russian olive	pedunculate oak	common ash	honey tree	pedunculate oak	common ash	pedunculate oak	bush mallow
blackthorn	common maple	Norway maple	silver mapple	Tatarian maple	wild pear	hazelnut	dog rose
wild pear	siberian elm	honey locust	hagberry	Turkish hazel	common maple	Siberian elm	staghorn sumac

Figure 3: The structure and cross-section of the shelterbelt, indicating the dominating tree species in each row, spring 2016.

As it was expected, the organic matter content was the highest under the forest land. However, the values of the enclosed arable land shows that in the middle of the field the organic matter content is higher than the values closer to the forest. In this paper, we present the map of the 0-10 cm layer, with the note that the other layers showed similar patterns (**Figure 4**).

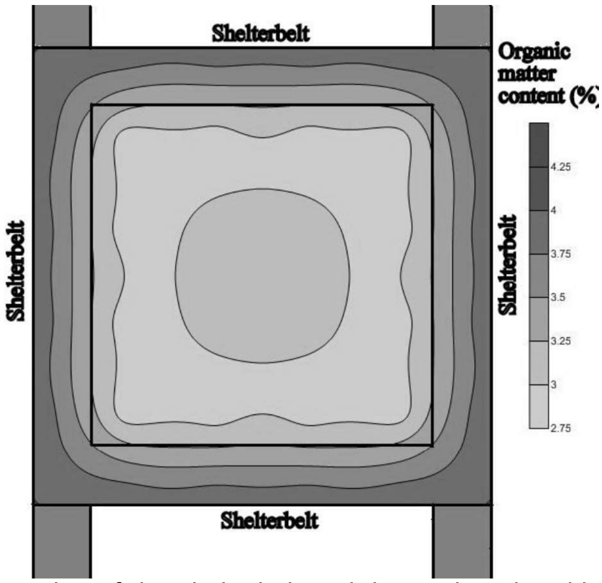


Figure 4: Soil map of a portion of the shelterbelt and the enclosed arable land that shows the changes of organic matter content of the top 0-10 cm layer of the soil

The shelterbelt provided habitat to numerous species, adding to its environmental value. A few of the observed species during field works were: ground beetles (Carabidae), roe deer (*Capreolus capreolus* G.) hare (*Lepus europaeus* P.) red fox (*Vulpes vulpes* L.) Red-footed falcon (*Falco vespertimus* L.), european turtle dove (*Streptopelia turtur* L.), etc.

Discussion

The value of the above discussed site has only been recognized recently, therefore further data acquisition, studies and researches are needed. We assume that the abundant blooming species in the shelterbelt with its increased surface exposed to full sun provides more flowers and more intense blooming throughout the vegetation period, resulting in a high value bee pasture serving increased amount of pollens and nectar.

We assume that the higher organic content of the soil in the middle of the field, compared to the neighbouring area of the shelterbelt could be explained by the shelterbelt's positive predominating effect on the crops, that is higher productivity, thus more residue remains in the soil. This was verbally confirmed by the farmer, who estimates that the yields are about 15% higher in these enclosed fields, compared to the neighbouring fields of his own, where each year he grows the same crops as in the sheltered fields, on a soil that is presumably holds similar characteristics. This needs to be confirmed following further measurements and analysis.

Acknowledgments

This study focused on agroforestry has been partly financially supported by VKSZ_12-1-2013-0034 - Agrárklíma.2 project.

References:

Borovics A, Gyuricza Cs (2015) Produce together with nature Agroforestry in focus. Agroinform 11: 12-17. (in Hungarian)

Gál J, Káldy J (1977) Forestation, Academic Publisher, Budapest (in Hungarian)

Keresztesy B, Halmágyi L (eds) (1975) The beepasture. Academic Publisher, Budapest, 791 p. (in Hungarian)

Keserű Zs (2014) Agroforestry in Hungary. Forestry Sites. CXLIX. 2: 49-50. (in Hungarian)

NFCSO (2015) Hungarian National Food Chain Safety Office, Forestry Directorate, Budapest